



# Bathymetry Improvement and Tidal Modelling at Regional Scales

#### North-East Atlantic and South-East Asian Seas

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# Context

- Global tidal modelling
  - Significant improvement in the last 10 years
  - Large errors (> 10 cm) remain on shelves, where tides are stronger and more complex
  - The global tuning of the model may not represent local specificities
  - Future developments, including increased resolution, are limited by computing capabilities





## Context

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  - The global tuning of the model may not represent local specificities
  - Future developments, including increased resolution, are limited by computing capabilities
- Regional tidal modelling
  - Higher resolution
  - Regional tuning easier to implement
  - $\rightarrow$  Needed for current and future satellite altimetry missions (SAR alti, SWOT)

→ But still limited by the quality of the ocean bathymetry that plays a key role in tidal dynamics, especially in shallow coastal waters and estuaries





A number of macro-tidal regions with bathymetry improvement potential have been identified





### Objectives

#### Selection of two regions, to start (CNES project)







- Inventory of existing / freely available bathymetry datasets
  - Raw data from single-beam or multi-beam soundings
  - Digital Elevation Models (DEM)
- Integration of these bathymetry datasets in the global database and visual assessment
- Implementation of a regional tidal model (hydrodynamic modelling) in the region of interest
- Validation of the tidal model with altimetry and tide gauge observations



#### Bathymetry data inventory

South-East Asian Seas





# Bathymetry data integration

- Merge of bathymetry datasets into the global LEGOS bathymetry (FES2014 basis)
  - Vertical reference identification, editing, sub-sampling, seamless boundaries...
  - More small scale features, more "realistic" isobaths lines



#### South of Taiwan – Luzon Strait



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  - Visual assessment to remove unrealistic patterns / erroneous datasets



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9



## Regional tidal modelling

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#### Validation results



 $\rightarrow$  Some improvement in the main regions where the bathymetry was modified.

→ Strong impact of the high resolution, with degradations in regions where the bathymetry was not modified (e.g. North-West Australian Shelf).

→ Need to improve the bathymetry in these regions to really benefit from the high resolution.



#### North-East Atlantic Ocean





#### Validation results

North-East Atlantic Ocean

Comparison to the tide gauges Vector differences for M2

#### Zoom in the Kattegat, between the North Sea and the Baltic Sea



OSTST meeting - 28 September 2018 - Ponta Delgada, Azores



# Validation results

#### North-East Atlantic Ocean



→ Reduction of error for all the tidal waves, compared to the non-assimilated FES2014 hydrodynamic solution.

- → Strongest reduction of error for M2 (1 cm for altimetry (27%), 7.5 cm for tidal gauges (43%)), K1 and S2.
- → Major improvements of tidal solution in the German Bight, the Bristol Bay and along the French Atlantic coast.
- → Very good performance of the regional model compared to the assimilated global tidal models.



### **Conclusions and Perspectives**

- Improvement of the bathymetry in two macro-tidal regions, using existing in situ datasets
- Implementation of two high resolution regional tidal models to assess the new bathymetry
- North-East Atlantic Ocean:
  - Very good performance and dramatic reduction of the errors, especially wrt tide gauges
  - This new configuration includes the German Bight (not available in global models) and the Baltic Sea
  - This new model could also benefit from assimilation and/or be patched in the FES2014 global model
- South-East Asian Seas:
  - Improvement of the tidal solution in regions where the bathymetry was modified
  - The high resolution model is more sensitive to bathymetry defaults, which leads to degradation in region where the bathymetry was not modified.



#### **Conclusions and Perspectives**

- Increasing the mesh resolution does not necessarily imply better tidal solutions, especially when the bathymetry is of poor quality.
- Other macro-tidal regions could benefit from this methodology.
- New methods for bathymetry detection using satellite data (optic and/or SAR) could also help improve bathymetry and tidal modelling in areas poorly covered by traditional in situ data.
- Arctic regional tidal model (Arctide2017) available upon request ! Cancet et al, Adv. Space Research, 2018



### Thank you for your attention !

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